Monolithic Organic Light Emitting Devices (OLEDs)/Optical Chemical Sensors and Sensor Arrays

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As part of a basic research effort studying the electronic interactions and fluorescence of organic materials, we have developed an integrated organic light-emitting device (OLED)/optical chemical sensor and sensor array, for which the potential applications range from simple cheap sensors to sensor arrays for basic and applied research in combinatorial chemistry, biochemistry, and *in vivo* biology (see Figure 1). Recently sensors made by several groups have been utilized to monitor various biochemical and biological processes, by tagging fluorescent markers onto the reactant compounds and organisms. Yet the detectors and light sources which excite that fluorescence have not yet been integrated with the sensor films. Consequently, the unintegrated devices are relatively bulky, expensive, and limited in use. The rapid developments in OLEDs and their inherent advantages such as scalability from the micro to the macro size, eventual negligible cost, versatile geometry, inherent flexibility, and ideal coupling with the sample leading to negligible heating effects, present opportunities to develop new monolithic sensors, microsensors, and addressable matrix arrays of sensors.

The monolithic sensors could provide a new platform for pure and applied combinatorial research in chemistry, biochemistry, and biological processes such as antibody-antigen reactions. In particular, the ability to fabricate transparent OLEDs and OLEDs with a ring or horseshoe geometry enables monolithic sensors operating in a "back detection mode," in which the detector is "behind" the OLED while the analyte is "in front" of it (see Figure 2). This geometry is far superior to the conventional "transmission" geometry, in which the detector is located beyond the analyte, i.e., "in front" of the OLED, since back-detection enables the miniaturization of the monolithic sensor and its application for basic and applied reseach in *in vivo*. Applications along these lines are now being pursued with the Iowa State University's John Papajohn Center for Entrepreneurship. This work is performed in collaboration with R. Kopelman (University of Michigan).

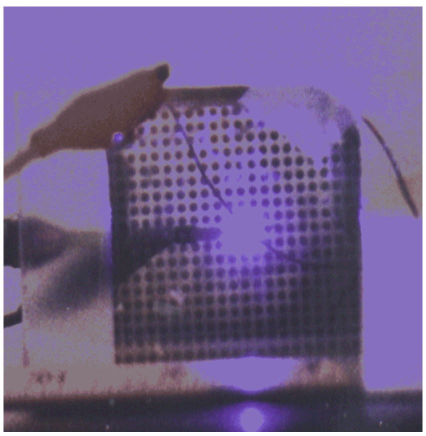

Figure 1. *Matrix array of blue 4, 4'-bis(2,2'-diphenyl vinyl)-1,1'-biphenyl (DPVBi)-based OLEDs for monolithic OLED/optical chemical sensor arrays; each pixel is ~1.5 mm in diameter.*

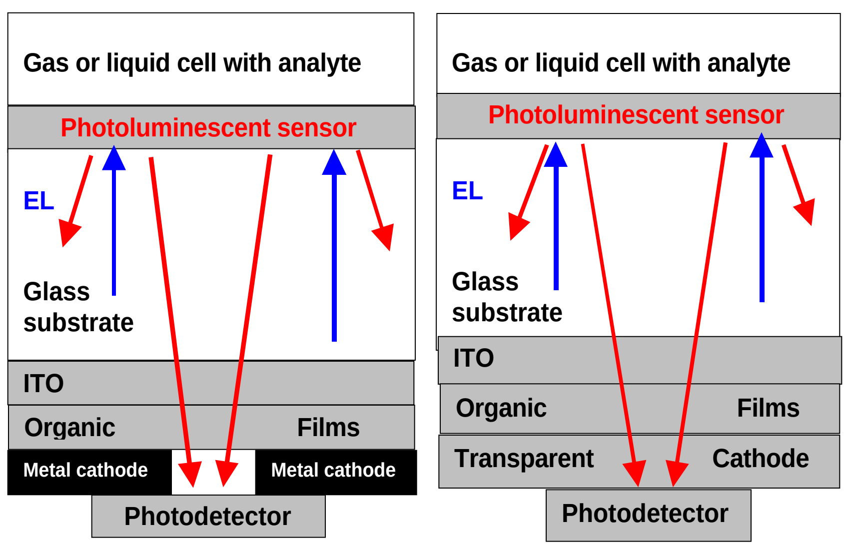

Figure 2. *Monolithic blue electroluminescence (EL) OLED/Optical chemical sensor with ring or horseshoe (left) or transparent (right) cathode geometry for "back detection" of analytes.*